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Another Side of a Low-Salt Diet: Reductions in the Salinity of Drinking Water May Lower Blood Pressure

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High sodium intake has been strongly associated with increased risk of hypertension.[1] In some coastal areas, highly saline drinking water adds to people's sodium intake. In this issue of *Environmental Health Perspectives*, scientists report that lower blood pressure and risk of hypertension among coastal Bangladeshi communities were associated with declines in salinity of drinking water sources.[2]

There are several causes of the salinity in Bangladesh and other low-lying deltas. For instance, in some coastal areas, groundwater is being overpumped to sustain shrimp farms, pulling deep, salty groundwater into shallower aquifers. Overextraction of both groundwater and fossil fuels allows seawater to penetrate porous deltaic sediments.[3]

Low-lying deltas, such as Bangladesh, are also vulnerable to sea level rise and storm surges that increase freshwater salinity, conditions that are expected to increase with a changing climate. "Our study suggests that millions of people in these areas are already consuming dangerous amounts of salt," says first author Pauline Scheelbeek, an epidemiologist at the London School of Hygiene and Tropical Medicine.

Scheelbeek's research focused on three districts, or *upazilas*: Dacope, Batiaghata, and Paikghacca, all located on the southwestern coast of Bangladesh. The communities there live mostly in polders, which are low-lying tracts of land protected from the sea by raised embankments along the Bay of Bengal.

For the current study, Scheelbeek's team worked with 581 adult participants from 12 villages. All the villages had high salinity levels in their drinking water. Half the villages had a Managed Aquifer Recharge (MAR) system in operation during the study, while the other half were on a waiting list to receive this technology. MAR systems collect and store rainwater underground for future use. Scheelbeek anticipated that drinking water collected in MAR systems would be less saline than water obtained from tube wells (stainless steel pipes bored into the aquifer) or from ponds fed by groundwater and rainfall.

In March 2013, the researchers collected baseline data for each participant, including analysis of sodium content in the individual's drinking water source(s), blood pressure, family history of cardiovascular disease, and estimates of dietary sodium intake. Follow-up data were collected in March and May of the following year.

According to the modeled results, blood pressure and sodium levels in drinking water were highly associated: on average, every 100 mg/L drop in sodium levels in drinking water was associated with a lowering of participants' systolic blood pressure (the pressure during a heartbeat) by 0.95 mmHg, and their diastolic blood pressure (the pressure in between heartbeats) by 0.57 mmHg.[2]

The researchers also detected an association between sodium levels in drinking water and occurrence of hypertension, which is defined as a blood pressure of 140/90 or higher in people under age 60, or 150/90 or higher in people over age 60.[4] Specifically, every 100 mg/L decline in drinking water sodium levels was associated on average with a 13.8% reduction in odds of hypertension.[2]

The water in MAR systems, however, did not always have lower sodium levels. "Some MAR systems worked well, and some did not," Scheelbeek says. "We could not conclude that MAR was a better alternative (drinking water source) based on our findings. The technology is promising, but it needs more research."

Scheelbeek says the predicted effects of a warmer global temperature—higher sea levels, more cyclones, storm surges, coastal flooding, and decreased river flows from inland areas—will likely accelerate saline intrusion and its health consequences. Cardiovascular disease is already highly prevalent in South Asia, and in Bangladesh, an estimated 20% of stroke deaths can be attributed to high-sodium diets.[5] Efforts to decrease sodium intake through drinking water could therefore prevent high blood pressure and associated morbidity in delta populations.

During prior research, Scheelbeek and her colleagues found that sodium levels in the drinking water in Dacope Upazila averaged 700 mg/L, with some measures exceeding 1,500 mg/L.[6] The World Health Organization (WHO) has not set a maximum threshold for sodium in drinking water, although amounts greater than 200 mg/L will affect the taste.[7] However, the WHO does recommend that sodium intake for adults from all sources should not exceed 2,000 mg/d.[8]

According to Scheelbeek, many people in Bangladesh have accustomed themselves to drinking salty water, and in the hot tropical climate, they can easily consume 2–3 L per day and thereby exceed the WHO threshold. "And that's not counting the additional sodium they also consume in food," she says.

In some people, the sodium in salt prevents the kidney from pulling water out of blood. The elevated volume of water in the bloodstream makes the heart work harder, which raises blood pressure. Untreated high blood pressure increases the risk of cardiovascular diseases.[9]

Samuel Myers, a senior research scientist at Harvard University's T.H. Chan School of Public Health, who was not involved in the study, says he agrees with Scheelbeek's conclusion. "I think it is plausible that climate change will increase saltwater intrusion into coastal freshwater systems around the world," he says. "And the finding that water salinity is contributing to preeclampsia in pregnant women[6] and now hypertension in

A study participant has her blood pressure checked as part of a new study on the relationship between hypertension and salinity of drinking water. In areas where high intake of sodium via food and salt water is a risk factor for hypertension, reducing sodium intake likewise may reduce risk. © Pauline Scheelbeek.

adults in Bangladesh[2] shows that global health impacts from anthropogenic environmental change are likely to be complex, often indirect, and frequently surprising."

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